

# Digitalized Search & Rescue

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# Background

- Approx. 300 SAR operations per year in Sweden
- Time critical and resource intensive activity
  - Large search areas
  - Difficult and dangerous terrain
  - Bad weather
- Camera equipped drones & helicopters powerful tools
- The lack of easily operated and autonomous systems a limiting factor\*



## Multi-sensor based search

### Goal

- Increased likelihood of detection and smaller number of false alarms
- More accurate localization
- More diverse search scenarios and operation conditions
- Larger search areas

### Sensors

- Recco detector, Camera, Thermal sensors, WIFI, BLE, etc.

## Autonomous planning

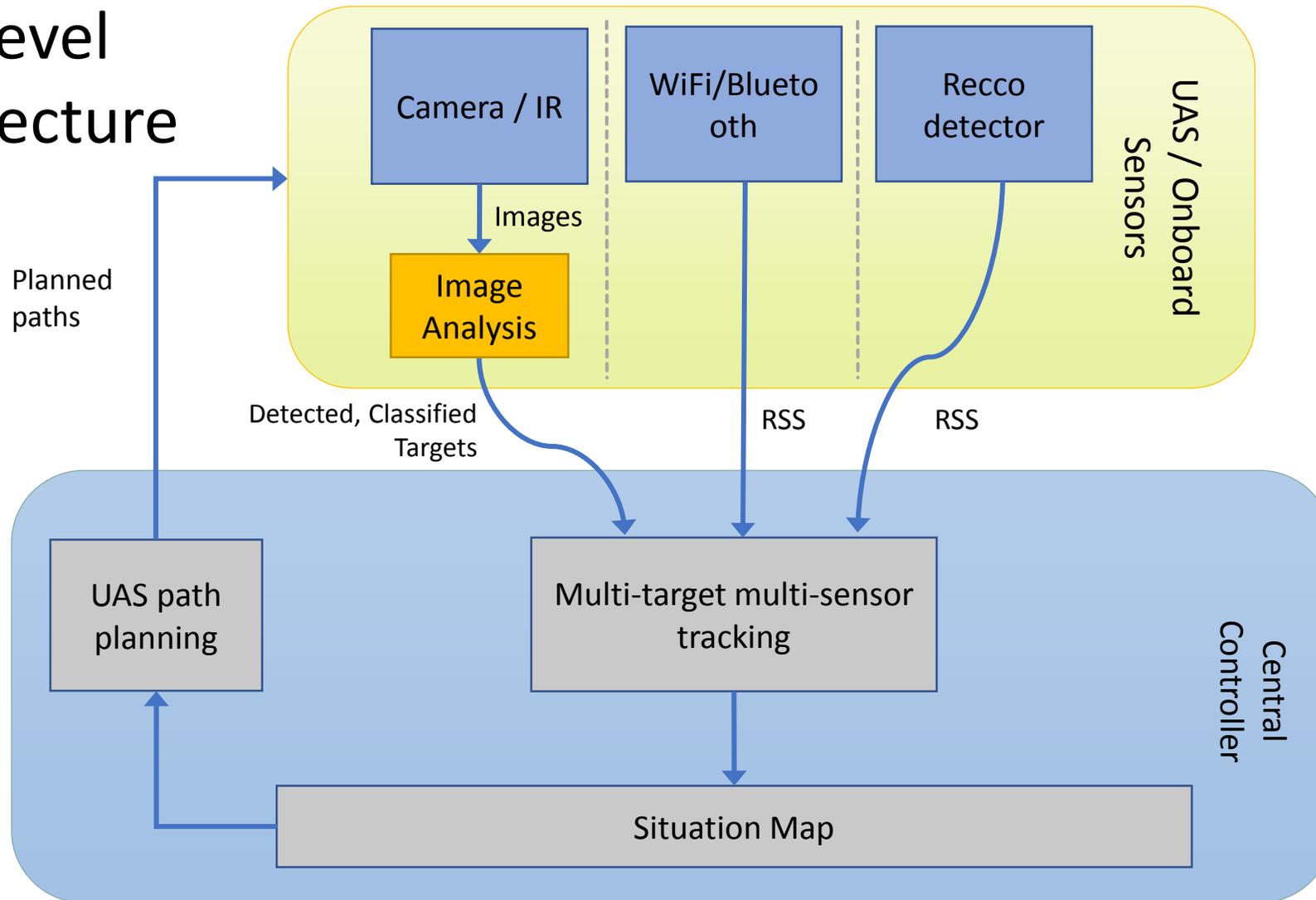
### Goal

- Minimum interaction with operator
- Optimization of search pattern based upon prior info. and retrieved meas.
- Automatic re-planning when operator adds new information

### Methods

- Informative motion planning, Motion planning under uncertainty, Belief space planning

# High-level Architecture



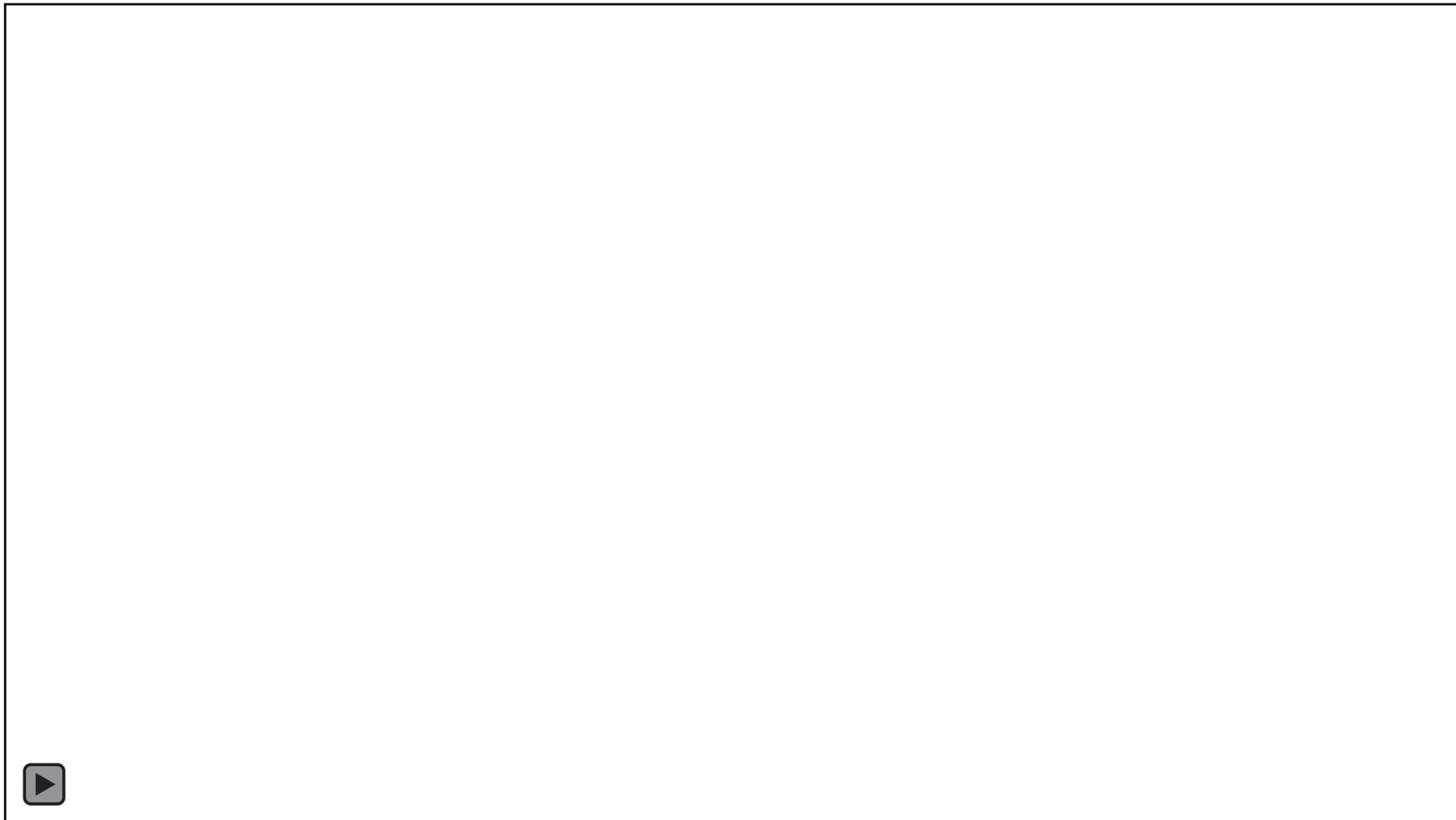
# WiFi localization

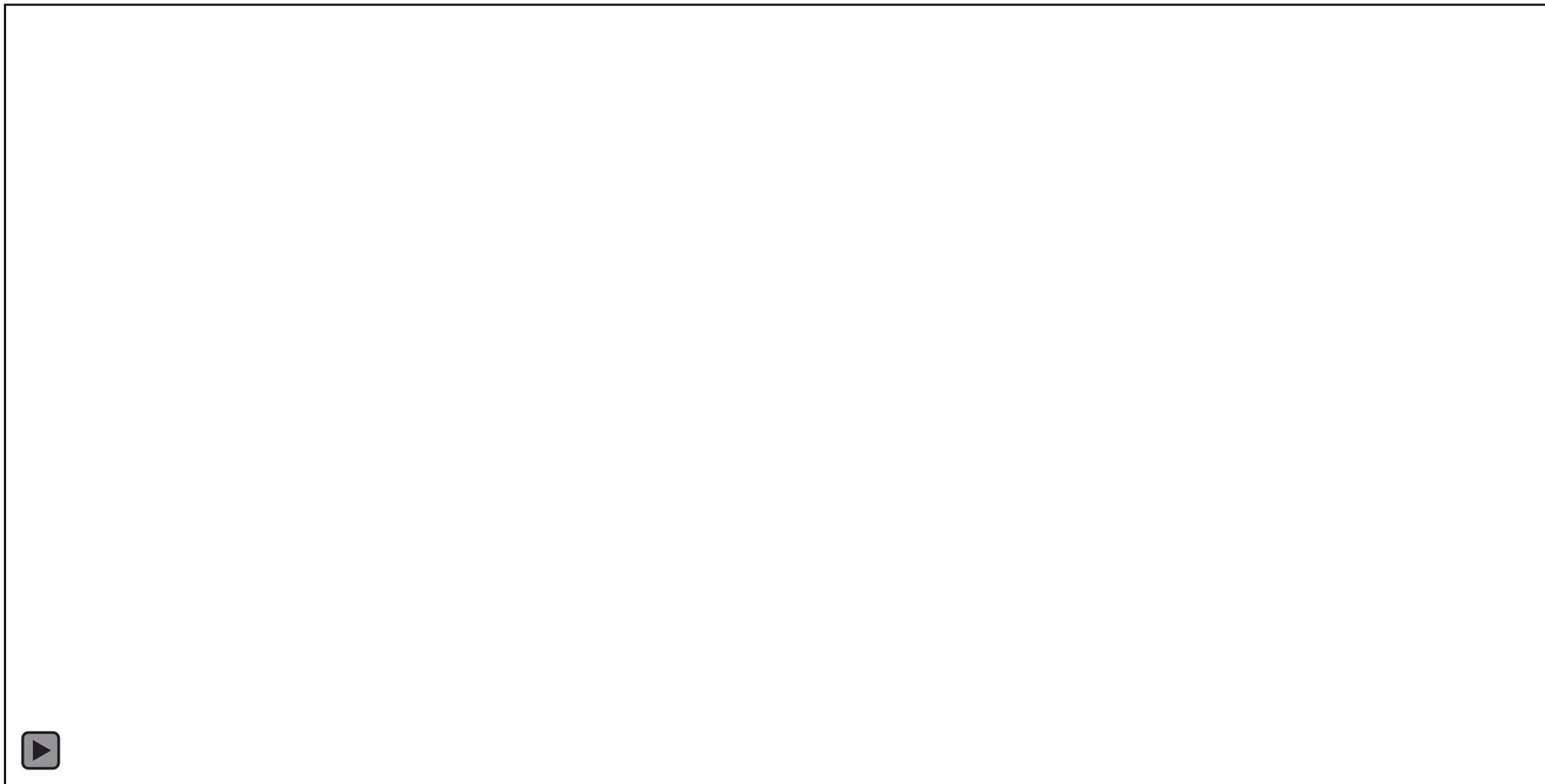


A drone with radio receiver scans RSS levels from the hidden cell phone. By multi-lateration techniques, the position of the cell phone is quickly determined.



# IR Camera







# Recco Systems

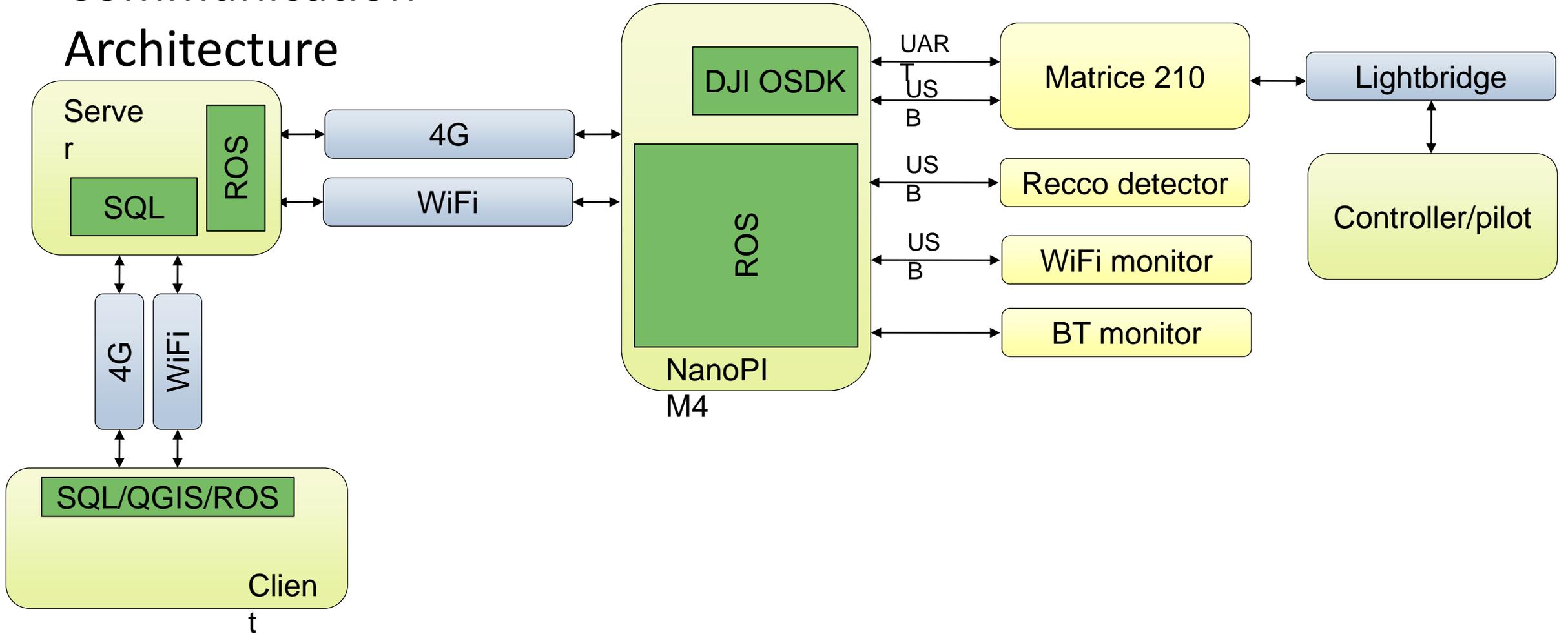


## Platform: DJI Matrice 210

- NanoPI M4
  - WiFi in monitor mode
  - Bluetooth
  - Hexa-core CPU for on-board video processing and control of host Matrice
- Digitally interfaced analog Recco detector



# Communication Architecture



# Automatic Control at Linköping University (LiU)



Faculty: 13 + 6 (adjunct) & 25 PhD students

Optimization for  
Control

System  
Identification

Sensor Fusion

Autonomous  
Systems

## Ongoing and previous drone/UAV projects

- UMS Skeldar, Intuitive Aerial, Vinnova/ LINK-SIC, 2018.
- Position and Trajectory Control of a Quadcopter Using PID and LQ Controllers, 2017.
- MarineUAS, EU. System identification, 2017.
- Följning av djur i Kolmården djurpark, 2017.
- Minröjningssystem, 2017.
- Autonomous Following and Filming of a Test Vehicle, 2016.
- Autonom målföljning med quadcopter, 2015.
- Modellering och styrning av en multirotor helikopterplattform, 2014.
- Reference Governor for Flight Envelope Protection in an Autonomous Helicopter using Model Predictive Control, 2014.
- Modeling, Estimation and Attitude Control of an Octorotor Using PID and L1 Adaptive Control Techniques, 2014.
- Autonom spaning med quadcopter, 2014.
- Trikopter med stabiliserad kamera, 2011.
- UAV med stabiliserad kamera, 2010.
- Landningsplattform för helikopter, 2008.
- Reglering av autonomt flygplan, 2008.